CHAPTER 6 - SOUTH INDIAN RIVER LAGOON

Seagrass and Water Quality

<u>Seagrass Resource Assessment</u>

The SFWMD's assessment of the South IRL seagrass resource is based on the same three measurement indices used in the Lagoon-wide assessment:

- Acres of seagrass coverage over time (net gain or loss)
- Maximum depth of the edge of seagrass beds, and
- Percent of sunlight that reaches the targeted depth of 1.7m

For more information on why and how these indices are used to assess seagrass resource status, refer to Chapter 2 pp. 2-3. Additional details, beyond the scope of this plan, on methods and results in the South Indian River Lagoon can be found at

<u>ftp://ftp.sfwmd.gov/pub/rbennet/docs/irl_sav_report.pdf</u>

Segment classifications based on the measurement indices described above are provided in Table 6-1. Major findings on the status of seagrass in the South IRL and are summarized below:

Table 6-1. General Classification[1] of South Indian River Lagoon Segments

South Indian River Lagoon	£ 20% of surface light @ 1.7 m	SDI £ 75 %[2]	Loss since 1940 ³ 50 %	Loss since 1940 ³ 75 %	Classification[2]
22	X	X			Fair
23	X				Good
24	X	X			Fair
25	X	X	X		Poor
26					Good

1. Classification is based on the following indices-related criteria: % surface light @ 1.7m, seagrass depth index or SDI (a measure of depth extent of seagrass relative to the target depth of 1.7 m; see Figure 6-1), and a percent loss of seagrass since 1940 (≥50 % and ≥ 75 %). Any segment receiving 3 or more marks is classified as poor, 2 marks fair, and 1 mark or less good
2. Based on 1992, 1994, 1996, and 1999 data.

- Segment 26 has better seagrass conditions than any of the other South IRL segments. This segment was ranked “good” (Table 6-1) and is the only South IRL segment that exceeded the specified light, depth, and acreage targets. Clear oceanic waters entering this segment from the Jupiter Inlet create such favorable” conditions for seagrass growth.
- Segment 23 also received a “good” ranking. Healthy seagrass beds are present within this segment. However, expansion of the beds throughout the segment to the 1.7 m depth target may be limited by periodic turbidity that reduces the light available for seagrass growth.
- Although Segment 22 received a “fair” rating it was very close to receiving a “good” rating (it missed the “good” rating by having an SDI of 74 % instead of 76 %). Recent mapping efforts and water quality data support continued improvement in segment 22. Seagrass acreage increased 29% from 1994 to 1999. From 1990 through 1999 water clarity improved due to decreases in chlorophyll a, TSS, and color and an increase in secchi disk depth.

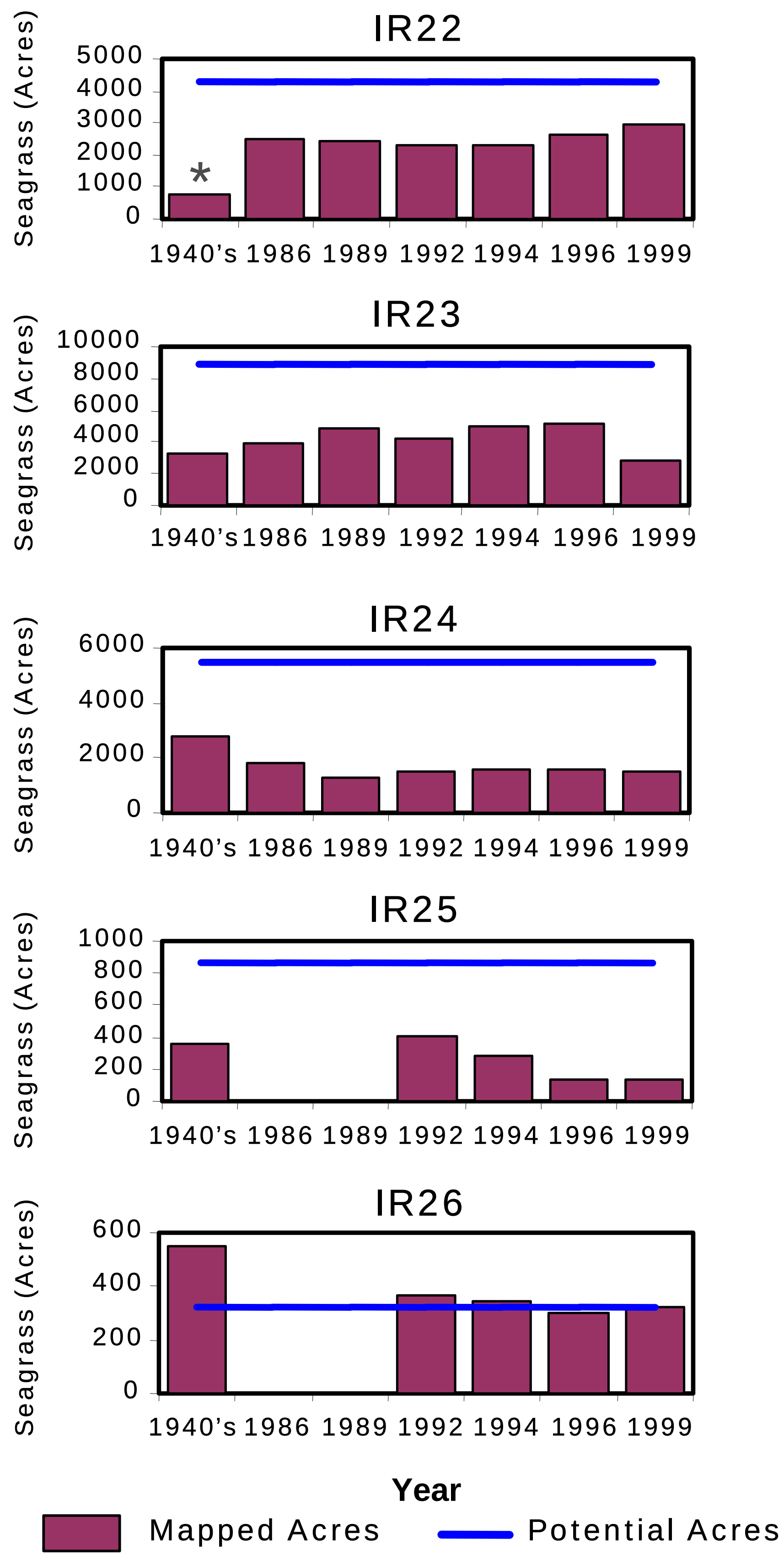


Figure 6-1 b. Acres of seagrass, by segment, in each year mapped. Note differing scales. Potential seagrass acres (the area < 1.7 m deep) are shown as a blue line.

* In IR22 seagrass acreage was 2,336 in 1958

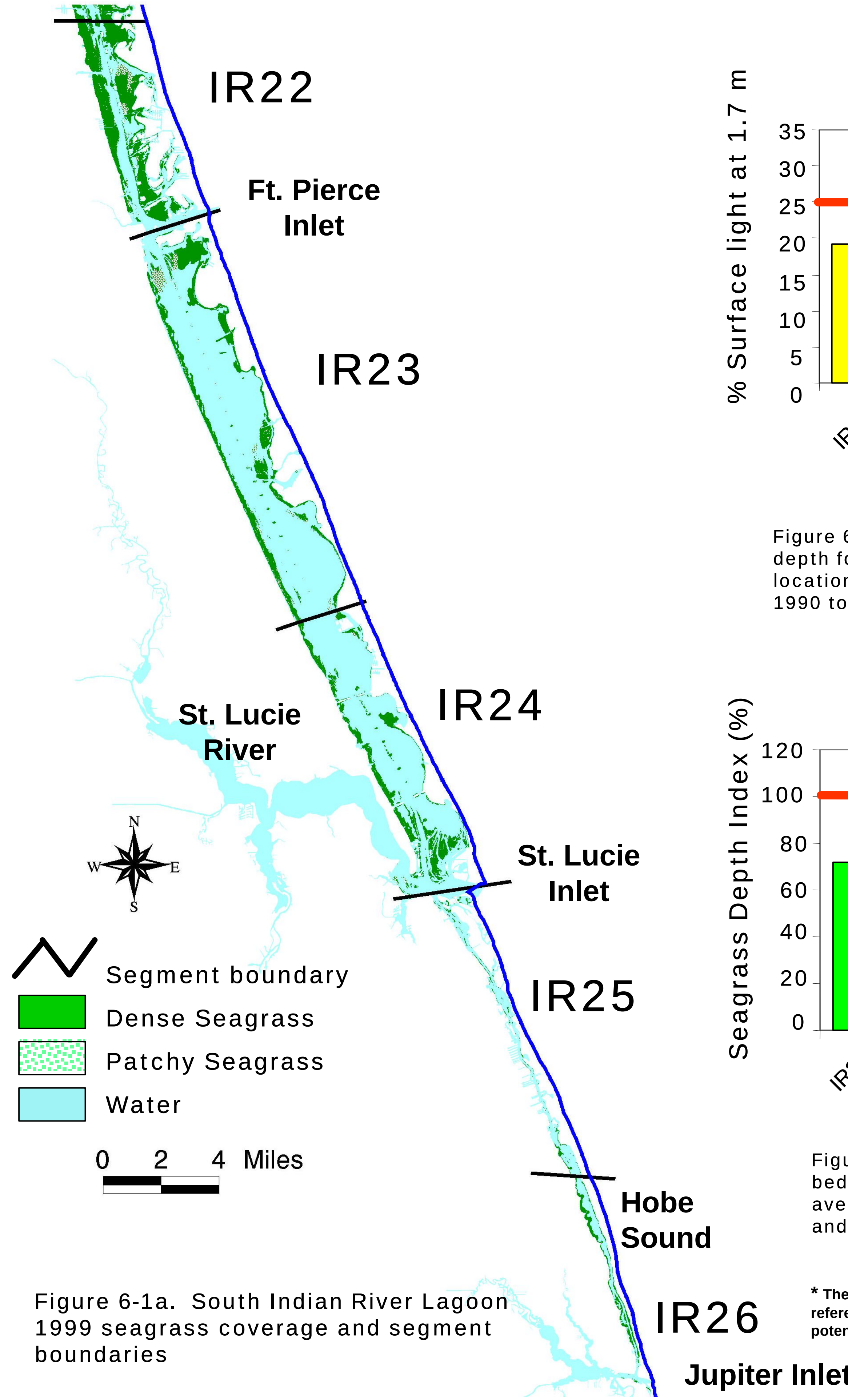


Figure 6-1a. South Indian River Lagoon 1999 seagrass coverage and segment boundaries

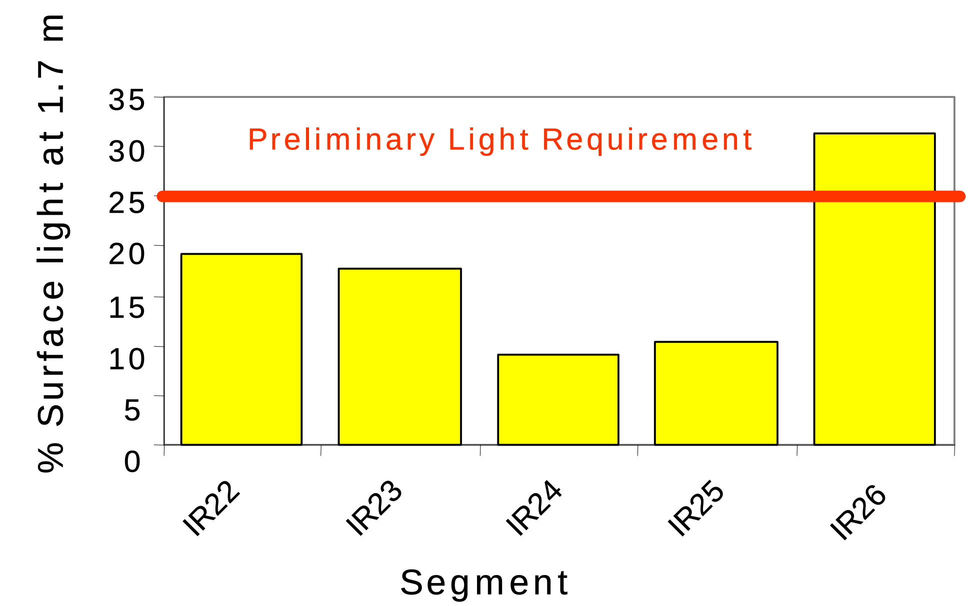


Figure 6-1c. Median percent surface light at the 1.7 m target depth for each segment, north to south (see map at left for location of segments). Based on monthly measurements from 1990 to 1999.

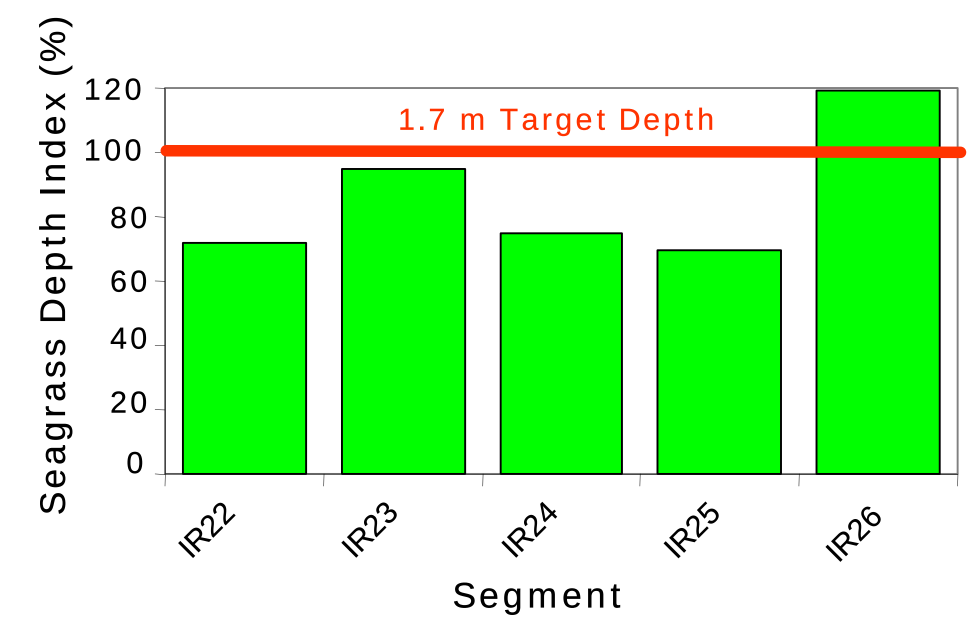


Figure 6-1d. Seagrass Depth Index = depth of edge of bed as a percent of the 1.7 m target depth*. Based on average seagrass deep edges mapped in 1992, 1994, and 1996.

* The Seagrass Depth Index (SDI) is based on potential coverage to 1.7 m referenced to the NGVD29 vertical datum. The SDI would be slightly less if potential coverage were referenced to mean water level (MWL).

- Segments 24 and 25, which receive freshwater discharges from the St. Lucie River, apparently support the least healthy seagrasses in the South IRL, with ratings of “fair” and “poor”, respectively. Seagrass acreages in both of these segments were consistently well below the target acreages and light available for seagrass growth was low. A 67 % decrease in seagrass acreage occurred in Segment 25 from 1992 to 1999. This segment received the only “poor” rating in the South IRL.

Total seagrass acreage in the South IRL during 1940 was similar to the acreage mapped in 1999 (Table 6-2). Although overall seagrass resources in the South IRL have remained fairly stable over the last sixty yea, when the seagrass data is evaluated by segment, it is clear that considerable seagrass acreage changes have occurred. Seagrass acreage was less in 1999 than in the 1940s in all segments except Segment 22.

Table 6-2. South Indian River Lagoon Seagrass Distribution, 1986–1999, and Seagrass Target Acreages.

Lagoon Segment No.	Total Seagrass Acreage Per Mapping Year							Target Acreage[1]
	1940	1986	1989	1992	1994	1996	1999	
22	764	2471	2435	2310	2307	2649	2978	4303
23	3244	3916	4815	4273	5007	5187	2856	8833
24	2754	1806	1279	1513	1571	1589	1520	5469
25	358	Not Mapped	Not Mapped	413	281	136	134	870
26	548	Not Mapped	Not Mapped	365	341	303	320	324
TOTAL	7668	8193	8529	8874	9507	9864	7808	19799

1. Submerged bottom acreage less than 1.7 m deep.

In Segment 22, acreage increased dramatically (2000+ acres) from the 1940s to 1999. During the early 1940s, seagrasses in this segment were affected by inlet dredging and construction of the north causeway. Additionally, once the current Ft. Pierce Inlet was constructed, seagrassses began colonizing sediments in the delta of the old inlet (located approximately one mile north of the current inlet). Seagrasses in segment 22 appear to have recovered from the 1940s impacts and have expanded over the old inlet delta resulting in greater acreage now than in the 1940s (Woodward-Clyde Consultants, 1994).

A major decline in seagrass acreage from 1996 to 1999 was observed in segment 23. However, review of field notes and photographs associated with the 1996 and 1999 mapping efforts revealed that much of the apparent decline could be due to photointerpretation difficulties associated with distinguishing algae from seagrass signatures (Robbins and Conrad, 2001). Consequently, detailed groundtruthing efforts are warranted along the east shore of segment 23 for future mapping efforts.

During large discharges from the St. Lucie Estuary or from C-25/Ft. Pierce Farms canal, plumes of freshwater are pushed into the South IRL during incoming tides. Contaminants, and especially particle-borne contaminants, are then deposited into otherwise unaffected areas of the South IRL. Impacts to the seagrasses south of the confluence with the St. Lucie Estuary were documented in 1998 as a result of the large releases from Lake Okeechobee.

To better understand the water quality/seagrass link in the South IRL, modifications have been made to the South IRL water quality monitoring network. Beginning January 2000, water quality stations were co-located with many of the seagrass transects in the South IRL (Figure 6-2). The monitoring was increased from quarterly to seven times a year. Data collected at the seagrass transects will help refine the water quality targets presented in this plan.

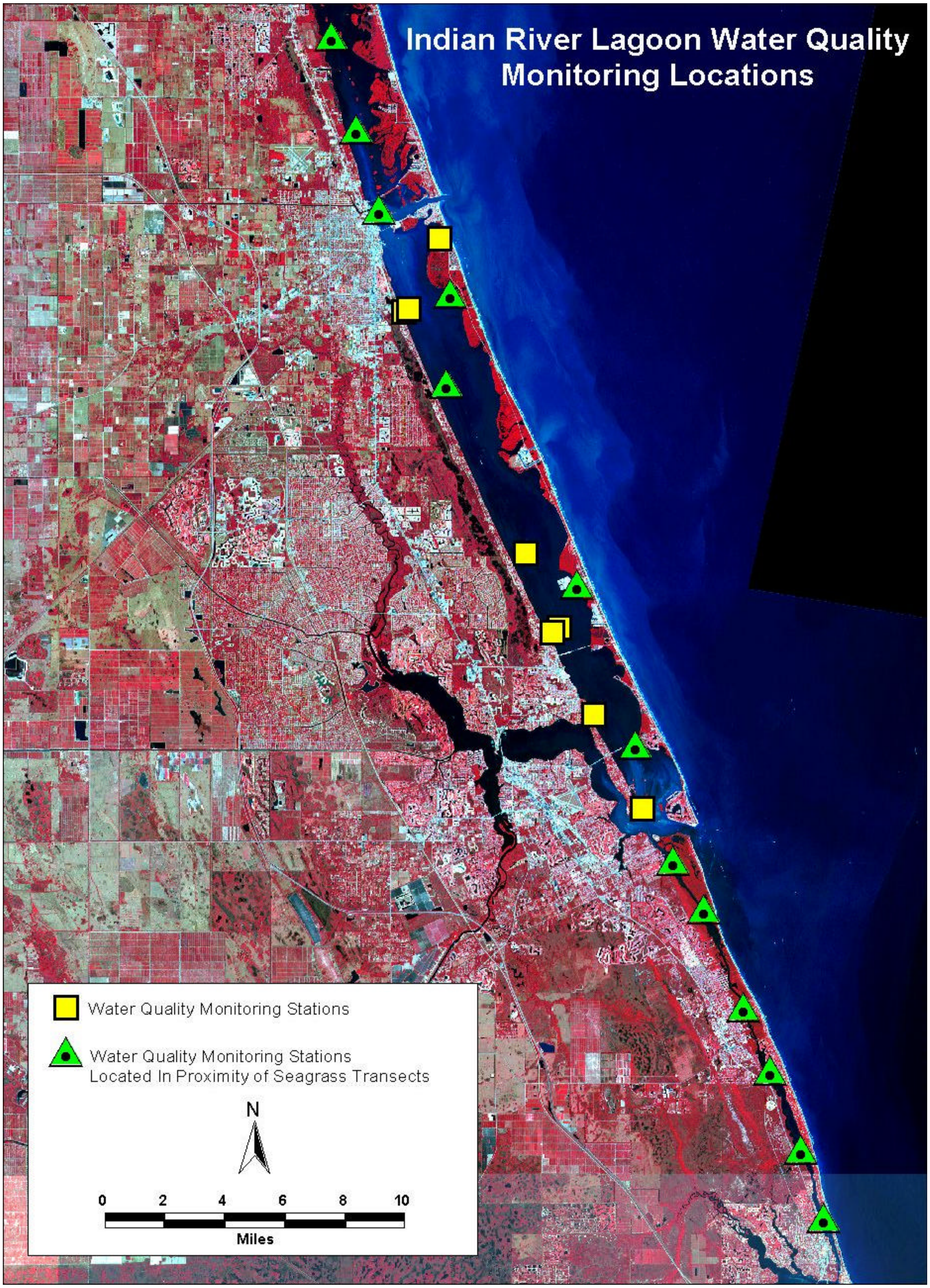


Figure 6-2. Revised Water Quality Monitoring and Seagrass Transect Sites

Water Quality Resource Assessment

The South IRL is less subject to the adverse disturbance of salinity than are areas where inlets are more removed from sources of freshwater (e.g., near Vero Beach or Melbourne; Woodward-Clyde, 1994a). Wet season reductions in South IRL salinity are usually confined to the areas adjacent to the C-25 canal near the Ft. Pierce Inlet, and the mouth of the St. Lucie River Estuary (SLE) near the St. Lucie Inlet (Woodward-Clyde, 1994b). The highest average salinity's, 29-33 ppt, are typically found in the Ft. Pierce, and Jupiter Inlet areas (Figure 6-3).

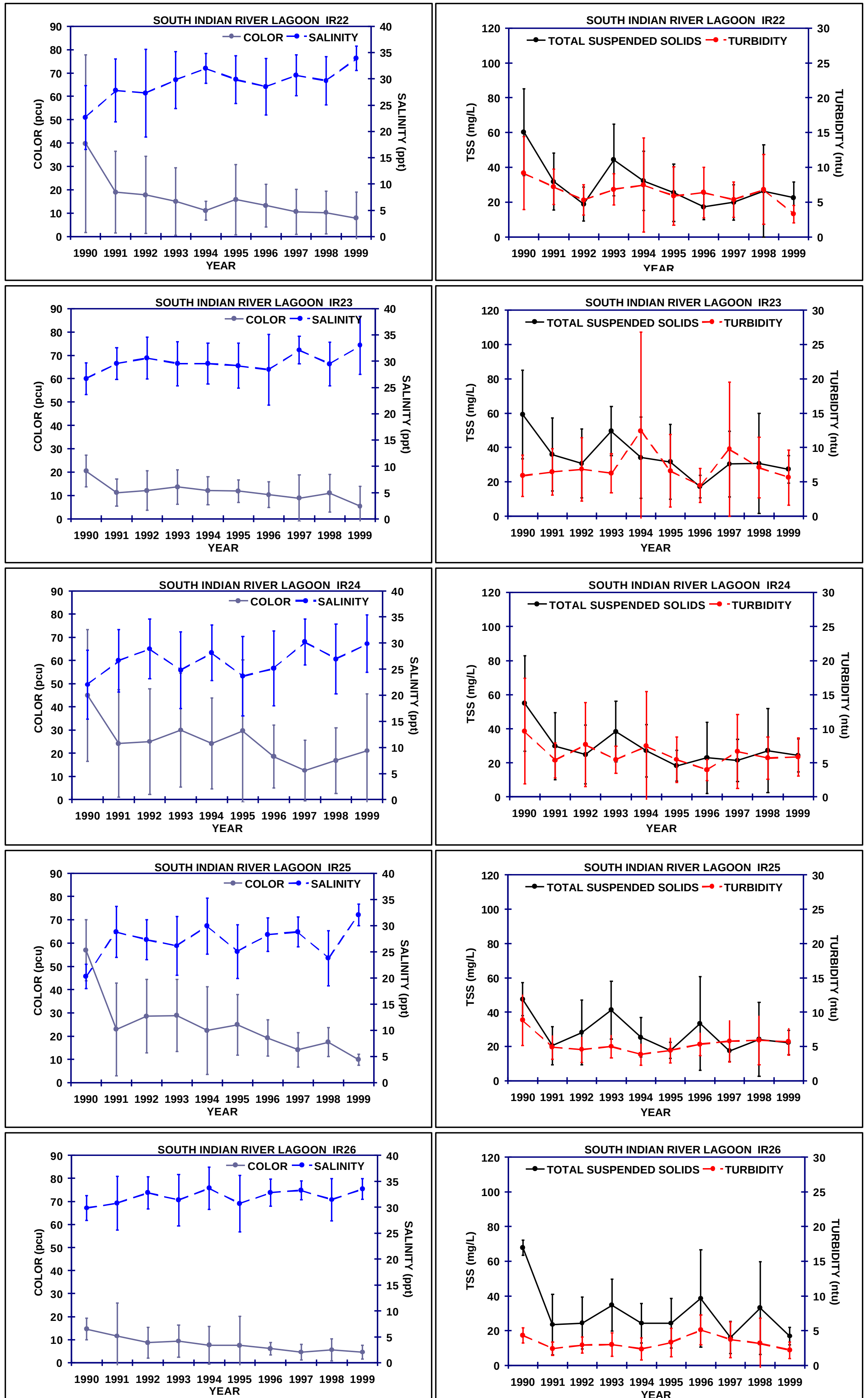
However, dramatic salinity changes in and adjacent to the South IRL were observed since the last SWIM Plan Update. In the winter and spring of 1998, freshwater releases from Lake Okeechobee through the S-80 structure on the St. Lucie Canal (C-44) began in December and steadily increased, with peak flows of 7000 cfs occurring between March 1 and April 20. These discharges from Lake Okeechobee, combined with local basin runoff, caused drastic decreases in salinity. The South IRL, normally averaging 30-ppt (part per thousand) salinity, decreased to 20 ppt during peak flows. The SLE, which normally averaged 24 ppt, decreased to 5 ppt during peak flows. The North Fork of the St. Lucie River, normally averaging 18 ppt, decreased to 0 ppt during peak flows. In 2000, the Lake Okeechobee Managed Recession Plan resulted in billions of gallons of freshwater being released to tide through the St. Lucie Canal.

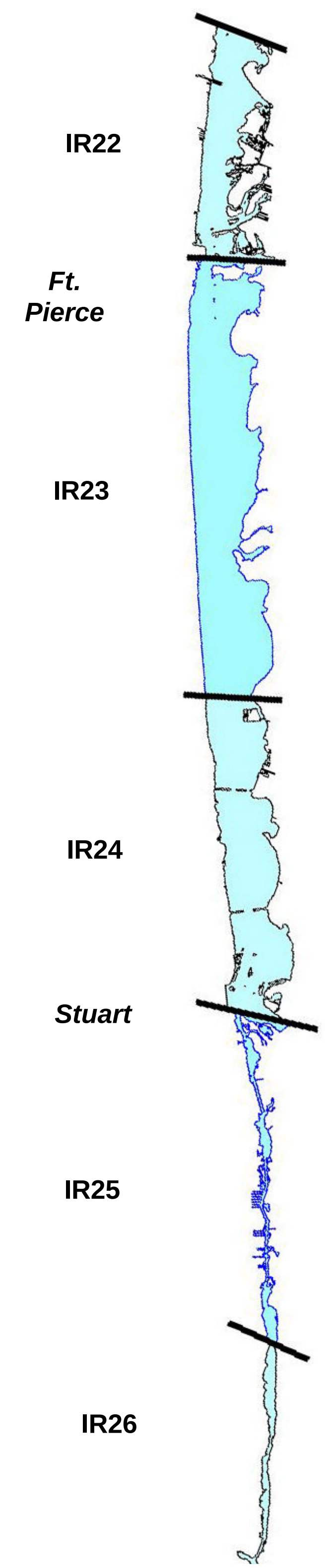
Establishing a suitable salinity environment is a basic prerequisite to promote a healthy estuary. Accordingly, SFWMD restoration efforts are focusing on determining what freshwater inflows are needed to provide the salinity regimes needed to support healthy, sustainable estuarine communities. During the 1990s, despite the events noted above, 10-year average salinities were above 20 ppt and generally well within the optimum salinity range for seagrass growth.

Analyses to date, indicate that salinity, color, and turbidity are the primary factors in the South IRL that affect the amount of light reaching the Lagoon bottom. Color generally tends to track salinity levels in the South IRL, where tributaries or canals discharge relatively high colored waters and, concomitantly, salinities are reduced. Some of the lower color levels are in the South IRL, with Hobe Sound near Jupiter Inlet standing out with the lowest 10-year average: <10 pcu. Turbidity levels in South IRL frequently average above 6 ntu. The segment immediately south of Ft. Pierce Inlet experiences both the highest 10-year average and the highest turbidity levels: ~7 ± 7 ntu. Color and turbidity directly influence the penetration of light through the water column.

Light is a major factor controlling the depth distribution of seagrass in the South IRL. Preliminary results indicate that color and turbidity are the primary factors in the South IRL that affect the amount of light reaching the Lagoon bottom (Table 6-4; SFWMD), as measured by K_{par} (a measurement of photosynthetically active radiation). Most of the increased color and turbidity in the South IRL are being delivered with high flows of fresh water discharge, which in turn reduce the salinity in the Lagoon. Therefore, reducing freshwater flows to the South IRL will increase average salinities and reduce turbidity, color, and light attenuation.

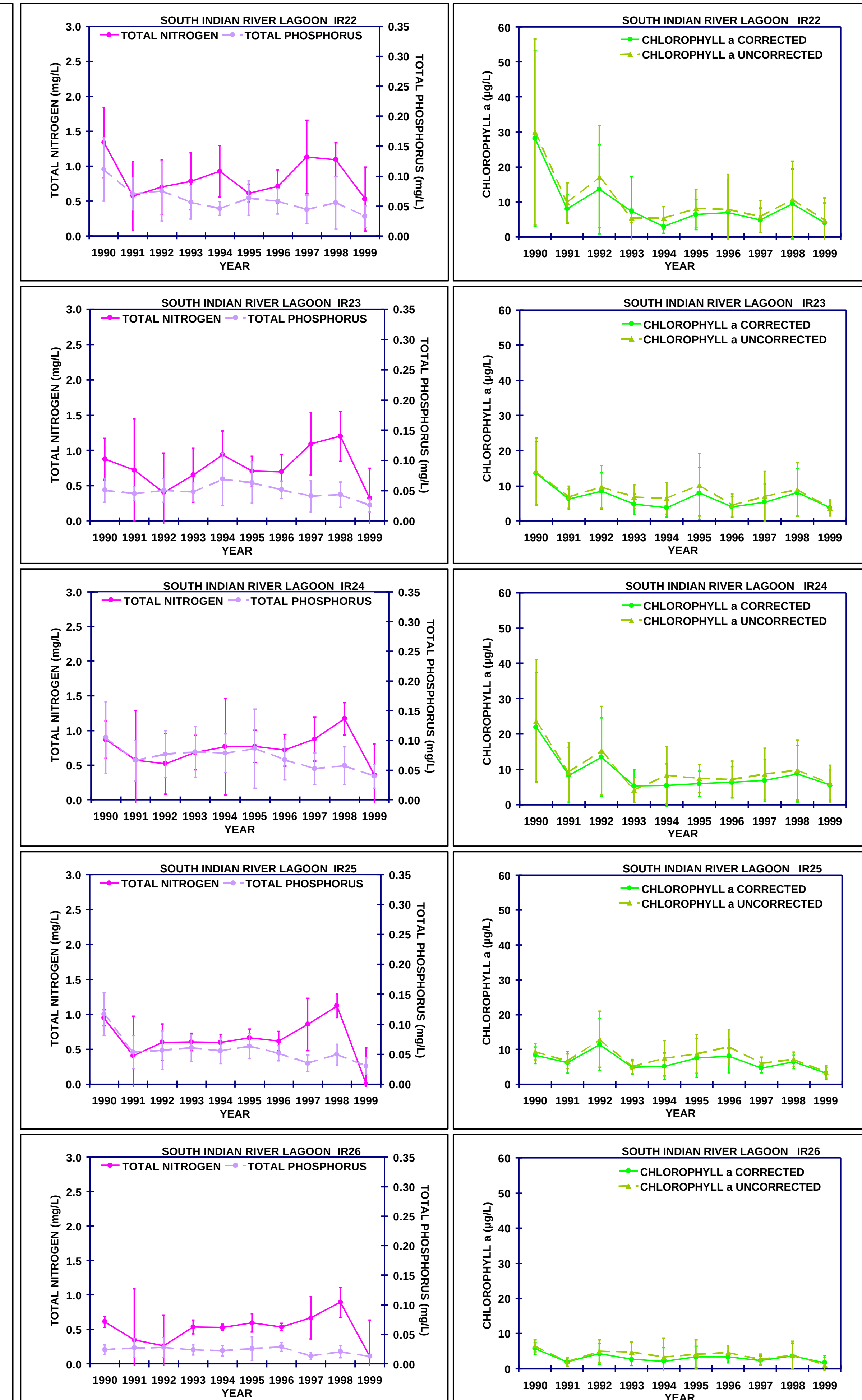
The South IRL segments near the Ft. Pierce and St. Lucie inlets appear to be aggravated by high turbidities, TSS, and nutrients. The area of the South IRL near the mouth of the St. Lucie River experiences higher than typical levels in TSS, color, and nutrients (TP being the most obvious). Turbidity levels in the South IRL frequently average above 6 NTU. The segment immediately south of the Ft. Pierce Inlet experiences the highest, as well as, the largest fluctuating turbidities of ~7 ± 7 NTU. Some of the lower color level sin the IRL occur in the South IRL. Hobe Sound near Jupiter Inlet had the lowest 10-year average: <10 pcu.





South Indian River Lagoon
(Segments IR22 – IR26)

Figure 6-3. Temporal Distribution of Color, Salinity, TSS, Turbidity, Total Phosphorus, Total Nitrogen, and Chlorophyll *a* corrected in the South Indian River Lagoon ($\bar{x}$± 1sd, 1990-1999 period of record).



Summary of Assessments

Seagrasses

- Acreage and distribution change in seagrass meadows were assessed at two to three year intervals between 1986 and 1999 for the South IRL. Change in areal extent of seagrass coverage was evaluated through a map to map comparison of data interpreted from aerial photographs. The acreage changes for the entire project area were relatively stable over the mapping period. However, when data was reviewed by lagoon segment, acreage trends and distribution changes became more apparent. Acreage losses were documented in all segments except one. Segments closest to the influence of the St. Lucie River showed declines in seagrass cover and/or low percent cover of potential habitat. Segments removed from the river's influence had relatively stable or increasing seagrass coverage. The healthiest seagrasses were found in the southernmost segment, where coverage of potential habitat exceeded 90 % in all years.
- Temporal trends in seagrass acreage as well as significant distributional changes not associated with net changes in acreage occurred within thirteen key areas (Robbins, and Conrad, 2001) Seagrass mapping and monitoring efforts are focusing on understanding the causes of the acreage and distribution changes in these key areas.
- Less than 50 % of the South IRL potential seagrass habitat was covered by seagrass in any year, therefore there is great potential to increase seagrass acreage.
- The lowest coverage of potential habitat is near the St. Lucie River in segments 24 and 25. On-going efforts to reduce pollutant loadings to the St. Lucie River are expected to improve water quality in Segments 24 and 25 and potentially lead to increases in seagrass coverage in these segments.

A study is underway to document seasonal changes in seagrass and associated macro-algae in segments 24 and 25. Data collected will be used to better understand the natural seasonal variability of seagrass and macro-algae in the study area, and the response of the seagrass community to freshwater discharge.

Water Quality

Water quality targets were established for all the parameters listed in Table 6-3, based on water quality concentrations in healthy seagrass beds. The concept is to maintain the median values and not exceed the 25th or 75th percentile values on an average annual basis. Efforts to meet these water quality targets and to manage freshwater flows through the St. Lucie River Estuary for environmental enhancement should help stabilize or increase the seagrass edge of bed depth and, therefore, improve the overall health of the South IRL.

Estuaries are the receiving water body for a variety of watershed inputs. Therefore, estuarine restoration and management strategies must be linked to watershed management of surface water, groundwater, and atmospheric inputs in addition to the internal processes occurring in the receiving water body. (see http://www.sfwmd.gov/org/wrp/). The new Water Supply and Environmental (WSE) regulation schedule for Lake Okeechobee discharges should provide more flexibility for discretionary releases of water for environmental benefits. In addition, pulse releases are prescribed to lower lake stage with minimal impact to the South IRL. The current status of seagrass and water quality monitoring projects in the South IRL is summarized in Table 6-4. Many of the projects that were designed to assess the current status of seagrasses and water quality have been completed. Efforts to monitor changes and trends in over time are continuing (see Chapter 2).

Table 6-3. Water Quality Targets for the South Indian River Lagoon

Parameter	25th Percentile	Median Value	75th Percentile
Dissolved Oxygen (mg/l)	5.67	**6.09**	6.55
pH Units	7.8	**7.9**	8.0
Salinity (ppt)	28.3	**30.4**	33.2
Secchi Disk (m)	1.00	**1.44**	1.56
Chlorophyll a (mg/m^3)	1.9	**3.1**	5.3
Nitrite (mg/l)	0.002	**0.002**	0.002
Nitrate (mg/l)	0.006	**0.008**	0.008
Nitrite + Nitrate (mg/l)	0.002	**0.004**	0.008
Total Kjeldahl Nitrogen (mg/l)	0.339	**0.676**	0.997
Total Nitrogen (mg/l)	0.595	**0.692**	1.095
Orthophosphate (mg/l)	0.009	**0.023**	0.037
Total Phosphorus (mg/l)	0.025	**0.053**	0.070
Total Suspended Solids (mg/l)	14	**20**	28
Turbidity (NTU)	1.71	**2.84**	4.59
Volital Suspended Solids (mg/l)	5	**8**	11
Color Units	5	**8**	13
K_{par} (Photosynthetically Active Radiation)	-1.5	**-1.2**	-1.0

Table 6-4. Description and Status of Seagrass & Water Quality Projects

PROJECT NAME	DESCRIPTION	STATUS	LEAD AGENCY
Seasonal trends in sea-grass and macro-algae in SIRL	Document seasonal changes in seagrass and macro-algae in the South IRL near the mouth of the St. Lucie River	Continuing	SFWMD
Aerial Photographs	Annual aerial photographs to prepare SIRL seagrass maps. The SFWMD is the lead for the SIRL portion of the lagoon wide mapping and photography.	Continuing	SFWMD
Seagrass Mapping	Map seagrass lagoon-wide from aerial photos and ground truthing 1986 - 1999. The SFWMD is the lead for the SIRL portion of the lagoon wide mapping and photography.	Completed	SFWMD
Indian River Lagoon Seagrass Transects	Monitoring two times a year of 6 transects that were installed in September 1994 from Jupiter to St. Lucie Inlet	Continuing	SFWMD
IRL Seagrass Transects - additional monitoring	Monitoring a subset of the SIRL transects was done in May 1998 during Lake Okeechobee regulatory releases (a similar effort was also done in 2000)	Completed	SFWMD
1999 Seagrass Data Summary	Analyzed trends of seagrass mapping data from 1986-1999; summarized data for deep edges of transects; developed recommendations for future monitoring; Input data for Pollutant Load Reduction Goal (PLRG) development process	Completed	SFWMD
Indian River Lagoon Tidal Station Monitoring 1999	8 stations in the South Indian River Lagoon between Ft. Pierce Inlet and Pecks Lake	Continuing	SFWMD
Indian River Lagoon Water Quality Monitoring Network	Forty stations monitored quarterly: 1989 - 1999	Completed	SFWMD
Indian River Lagoon Water Quality Monitoring Network Revised 2000	21 stations monitored seven months/year. January 2000 to present.	Continuing	SFWMD
Water Quality Data Summary	Trend analysis and summary of water quality data; recommendations for future monitoring; Input data for PLRG development process	Completed	SFWMD
Indian River Lagoon Bathymetry 1998	Indian River Lagoon bathymetry completed as of 1998	Completed	SFWMD

Progress on Projects

Strategies for Pollutant Load Reduction

There has been, and continues to be, a variety of new and on-going activities in the South IRL Watershed. Many of these activities immediately contribute to the achievement of SWIM goals and objectives.

Pollution Load Reduction Goal (PLRG) Development

In the South IRL, a two-step approach is being taken to develop PLRG's. The first step was to develop concentration targets based on the establishment of healthy seagrass. Healthy seagrass beds were identified and statistical analysis was performed based on 10 years of water quality data from those locations. These numbers were then used to establish water quality targets for the South IRL Table 6-3. The next step will be to use these water quality target values, to develop Pollutant Load Reduction Goals (PLRGs) for the South IRL. Ultimately, the "in-lagoon" water quality target values will be used in conjunction with hydrodynamic/water quality and watershed modeling to evaluate pollutant load reductions needed in the watersheds to meet the targets. Water quality concentration targets will be reevaluated and possibly modified as additional data and modeling results become available.

A comparison of the South IRL water quality target values with the median wet season water quality from all forty South IRL water quality stations (July and October data from 1990 - 1999) is provided in Table 6-5. A high percentage of these values exceed the South IRL water quality targets. This suggests a need to improve water quality for the restoration and protection of seagrass resources in the South IRL.

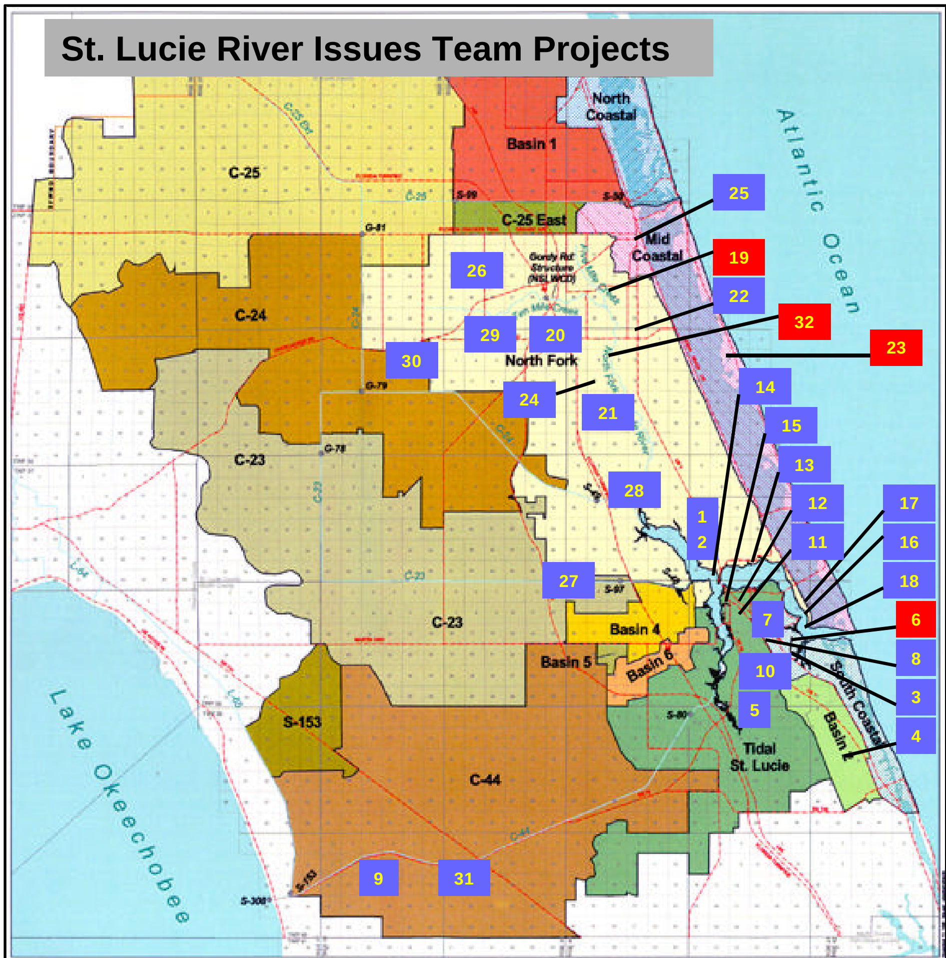
Table 6-5. Comparison of Water Quality Targets to Measured Values, 1990-1999

Parameter	Median Target Values	No. of Samples	No. of Exceedances From Target Values		Percent Exceedance from Target Values
			Dry Season	Wet Season	
Color units	**≤ 8**	**1216**	**340**	**450**	**65**
Turbidity (NTU)	**≤ 3**	**1310**	**599**	**434**	**79**
Salinity (ppt)	**≥ 30**	**1043**	**251**	**250**	**48**
K_{par} (Photosynthetically Active Radiation)	**≥ -1.2**	**600**	**138**	**143**	**47**
Chlorophyll ***a*** **(**mg/m$^{3)}$	≤ 3.1	1139	348	414	67
Total Phosphorus (mg/l)	≤ 0.053	1230	178	240	46
Orthophosphate (mg/l)	≤ 0.023	1154	133	250	34
Total Kjeldal Nitrogen (mg/l)	≤ 0.676	1302	289	310	46
Total Nitrogen (mg/l)	≤ 0.692	1124	236	329	50
Nitrite + Nitrate (mg/l)	≤ 0.004	1312	339	272	46
Dissolved Oxygen (mg/l)	≥ 6.09	1253	123	317	35
Volatile Suspended Solids (mg/l)	≤ 7.5	1312	319	330	50
Total Suspended Solids (mg/l)	≤ 20	1303	383	309	53

*Bold values indicate significant correlation to seagrass edge of bed depth

St. Lucie Issues Team Projects

Additional efforts in the South IRL have been funded by the state legislature for the projects nominated by the St. Lucie River Issues Team. This additional funding has greatly accelerated the implementation of many of these projects (Figure 6-4 and Table 6-6).



Habitat Restoration

Stormwater Quality Improvement

BASINWIDE PROJECTS

IFAS
- Citrus Pesticide BMP
- FY&N
- N, P, Heavy Metals in Runoff from Citrus & Vegetable Fields Phases 1, 2, 3
- Water Table Mgmt as a BMP in Citrus Groves Phases 1, 2, 3
- Agrochemical & Nutrient Loadings - Pastures, Golf Courses & Urban Areas in SLE Basin Phases 1, 2, 3
- Muck

NOAA/ NOS/NMFS
- Environmental Toxicity in SLE / IRL, Phases 1, 2, 3
- Fish Health Problems in the SLE

NRCS
- Citrus Irrigation - Microjet Conversion - 3 years

USGS
- Pesticide Reconnaissance within the SLE

USDA
- Watershed and Aquatic Research Assessing Key Environmental issues in the St. Lucie Estuary

Martin County Projects
1 - Palm Lake Park Phases 1, 2
2 - North River Shores
3 - SY&CC, North River, Normand St. Weirs
4 - Poinciana Gardens
5 - Fern Creek - Phases 1, 2
6 - Willoughby Creek
7 - Airport Ditch
8 - Golden Gate Retrofits - Phases 1, 2
9 - RUSS - Dupuis Restoration - 2 years
10 - Salerno Creek Retrofit

Countywide
- Vacuum Truck
- MSWCD Urban MIL - 2 years

City of Stuart
11 - Poppleton Creek - Phases 1, 2
12 - Frazier Creek - Phases 1, 2
13 - Haney Creek - Phases 1, 2
14 - Fork Road CRA
15 - Krueger Creek

Sewall's Point
16 - Mandalay/Marguerite
17 - Rio Vista Outfall Retention Area Retrofit
18 - Island Road Bafflebox (referred to NEP)

St. Lucie County Projects
19 - Platt's Creek Phases 1, 2
20 - NSLR Retrofits
21 - Hidden River Estates
22 - White City Canal F
23 - Mosquito Impoundment Restoration IX
24 - River Park Water Quality Improvements

Countywide
- SLCSWCD Urban MIL - 2 years

City of Ft. Pierce
25 - Moore's Creek

NSLSWCD
26 - NSLSWCD BMP Implementation

SFWMD
27 - C-23 Dredging
28 - C-24 Bank Stabilization - Phases 1, 2
29 - Ten Mile Creek - Phases 1, 2, 3
30 - PC38
31 - C-44 STA

St. Lucie Estuary/Indian River Lagoon
- Ag BMP Cost Share
- SLE Water Quality Monitoring
- IRL Water Quality Model - Phases 1, 3
- Oyster Restoration - Phases 1, 2

DEP - CAMA
32 - NFSLR Wetland Connection - Phases 1, 2

Figure 6-4. Location of St. Lucie Issues Team Projects, 1999-2001

Table 6-6. St. Lucie Issues Team 2002-2003 Rankings

Project Title	Sponsor
Pine-Riverdale Retrofit	City of Stuart
Water Quality Enhancement BMP	FPFWCD
Water Table Management as a BMP I/R Citrus	IFAS – IRREC
Water Quality Enhancement BMP	NSLRWCD
S. Sewall's Point Road Via Lucindia	Sewall's Point
Citrus Irrigation Conversion	USDA
Savannas Ecosystem Management Project	St. Lucie County
NFSLR Acquisition and Restoration	St. Lucie County
Cedar Pointe Water Quality Retrofit	Martin County
St. Lucie Estuary Watershed Citrus BMP – Water Quality Management	SFWMD
N, P, and Heavy Metals from Citrus Groves and Vegetable Fields	IFAS – IRREC
Coral Gardens Basin Water Quality Retrofit	Martin County
South Sewall's Point Road Mandalay	Sewall's Point
St. Lucie Fish health as Biological Performance Measure	NOAA
Golden Gate Phase 3 Water Quality Retrofit	Martin County
Rio SL WQ Improvements	Martin County
Environmental Toxicity in SLE/IRL	NOAA

Non-Point Source Strategies

Stormwater Discharge

Water quality impacts to the South IRL are dominated by stormwater runoff from urban and agricultural sources. Several strategies are being implemented in the South IRL watershed to better manage urban and agricultural runoff. Implementation of best management practices (BMPs) is on-going. Stormwater utilities are in place in each county. Counties, municipalities, and other agencies in the watershed have a variety of stormwater retrofit projects. Many of the SFWMD actions to ensure a more natural delivery and supply of good quality freshwater to estuaries occur in the watershed. These are currently being accomplished by instituting BMPs and construction of sub-regional storage and treatment facilities. Long-term solutions to excessive freshwater discharges to the South IRL will be addressed through CERP projects, specifically, The IRL-South Plan and the Lake Okeechobee Restoration Plan.

Best Management Practices

As outlined in the Florida Watershed Restoration Act (1999), Florida agriculture is encouraged to develop effective voluntary BMPs to help meet state water quality goals. The Indian River Citrus BMP Implementation Committee, a collaborative public/private group, guides the process for voluntary implementation of citrus BMPs in the watershed. Activities of the committee include identification of research and educational needs, work on rule development, and on-going support for implementation of science based BMPs. Aiding in this effort are various agencies and groups that are providing funding for technical projects and cost sharing for grower implementations (Figure 6-5). For additional details see http://www.irrec.ifas.ufl.edu/.

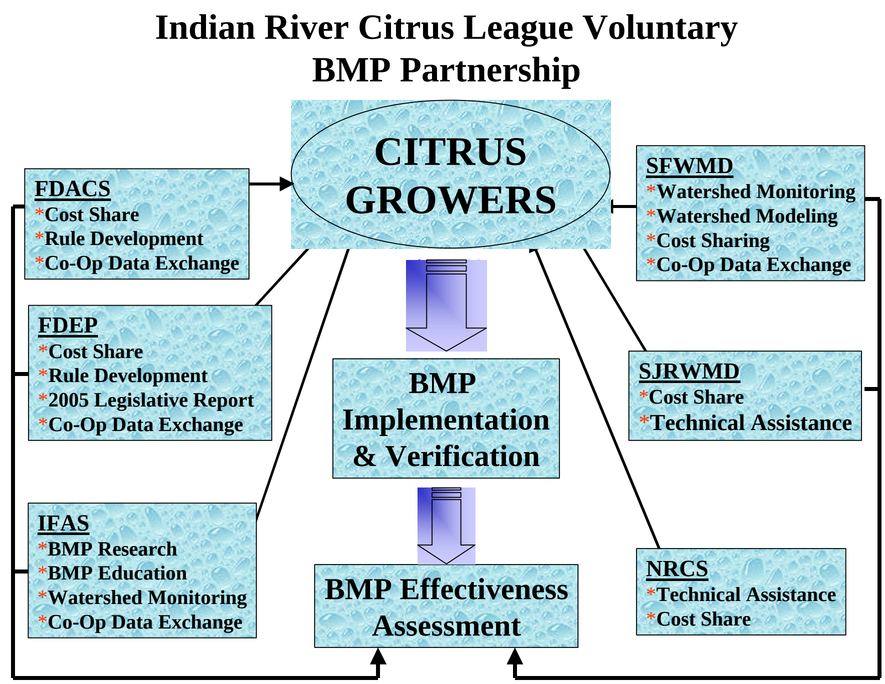


Figure 6-5. Agencies and groups provide funding for technical projects and cost sharing for growers to implement agricultural Best Management Practices (BMPs).

Muck

The Taylor Creek Sediment Removal project is projected to begin in 2003. This is a large project that will remove approximately 225,000 cubic yards of material.

Septic Tanks

Pollutant loads from on-site disposal systems (OSDS, a.k.a.,"septic tanks") or from inflows of groundwater contaminated by OSDS are considered by many to pose a potential threat to water quality in certain areas with close proximity to the lagoon and its tributaries. However, conclusive evidence is not available without site specific surface water/ groundwater monitoring. Progress has been made by local governments to identify priority areas and develop plans to convert OSDS to central sewer systems within the South IRL watershed. Ongoing groundwater monitoring studies that are underway by the SFWMD will provide data on both the quantity and quality of water entering the lagoon.

Project Descriptions and Status

A number of projects are underway to reduce pollutant loading from the South IRL Watershed. Many of these activities immediately contribute to the achievement of SWIM goals and objectives. The current status of pollutant load reduction projects in the South IRL is summarized in Table 6-7. One large retrofit project has been completed and the remaining efforts are continuing or underway.

Point Source Strategy – Domestic Wastewater Treatment Plants

In the South IRL, significant reductions in pollutant loading from domestic wastewater treatment plants (WWTPs) have been achieved since the mid-1980s. Consequently, domestic WWTPs appear to be a very minor source of pollution thanks to local government action in response to the IRL "No Discharge" Act (Chapter 90-262, Laws of Florida).

Table 6-7. Description and Status Pollutant Load Reduction Projects

PROJECT NAME	DESCRIPTION	STATUS	LEAD AGENCY
Non-point Source Strategy: Surface Water Drainage			
Salerno Creek Retrofit	Improve stormwater quality and flood protection in a 700 acre watershed, that discharges to SIRL. Construct a 23 acre wet detention lake discharge weir, and passive park along Salerno Creek.	In Progress	Martin County, Office of Water Quality
Sewalls Point Baffle Boxes	Install several baffle boxes to treat previously unimpeded stomwater discharges to the SIRL.	In Progress	Town of Sewalls Point
Moores Creek Retrofit	Improve stormwater runoff quality and existing level of flood protection in the 2,380 acre basin. Construct four water control structures, littoral shelves on canal banks and baffle boxes at major inflow points to the Creek.	In Progress	City of Ft. Pierce
Virginia Avenue Retrofit	Improve Stormwater Quality at Ft. Pierce discharge to SIRL	Complete	City of Ft. Pierce
Citrus BMP Implementation	Cost sharing implementations of BMPs for citrus systems in the St. Lucie Estuary and Indian River Lagoon watershed	In Progress	DACS, SFWMD, & Treasure Coast, Resource Conservation and Development Council, Ft. Pierce
Indian River Citrus BMP training for equipment operator and applicators	U of F, IFAS, and St. Lucie County Extension education and training in Martin, St. Lucie, and Okeechobee counties	Continuing	UF Extension, St. Lucie County
FL Yards and Neighborhoods (FY&N)	Educate and train for improved home, lawn and plant maintenance to improve water quality on site	In Progress	UF Extension, St. Lucie County
Manatee Creek Basin Water Quality Retrofit	The proposed water Quality retrofit improvements include an 11 acre detention area, creek improvements and installation of weirs for stormwater management. The project will reduce freshwater discharges, sediments and nutrient loading to Manatee Pocket and the SIRL.	In Progress	Martin County
Non-point Source Strategy: Muck			
Taylor Creek Dredging	Remove approx. 225,000 cubic yards of sediment. Currently in permitting phase.	In Progress	St. Lucie County

WWTP loadings of nitrogen and phosphorus have decreased by several orders of magnitude since 1986 (SJRWMD and SFWMD, 1987). Today, WWTP contributions of TN (~3,800 lb/yr), TP (~320 lb/yr), and TSS (~2,700 lb/yr) represent a miniscule fraction of the total surface water loading of these constituents to the South IRL. These small contributions primarily originate with just one WWTP at Ft. Pierce Inlet, which is operated by the Ft. Pierce Utility Authority.

Monitoring, Modeling and Applied Studies

Descriptions and status of Monitoring, Modeling, and Applied Studies projects are summarized in Table 6-8.

Monitoring

The objectives of South IRL Water Quality Monitoring are to: 1) develop a long term water quality data base to assess trends and support modeling; 2) evaluate ambient water quality in the South IRL; 3) establish a correlative link between water quality and the health of seagrass in the South IRL using the best available data; and 4) to use water quality at the healthiest seagrass sites to establish water quality targets for restoring seagrass in the South IRL.

In cooperation with Florida Department of Environmental Protection (FDEP), Bureau of Survey and Mapping (BSM) tide/salinity stations were installed in the St. Lucie Estuary in 1997. Tide (water surface elevation), currents (flow velocity), salinity, and temperature are recorded

Table 6-8. Description and Status of Monitoring, Modeling, & Applied Studies Projects.

PROJECT NAME	DESCRIPTION	STATUS	LEAD AGENCY
Water Table Management BMP	Use water table management as a BMP for reducing discharges from Indian River citrus groves	In Progress	UF, IFAS, IRREC, Ft. Pierce
St. Lucie Estuary Nutrient Loading Monitoring	Nutrient/sediment loading monitoring in C-23, C-24, C-25, and C-44 canals and Five and Ten Mile Creeks	On-Going	SFWMD
Ground Water/Surface Water Interaction Monitoring Network	15 monitoring wells at six sites to gather data on surface-groundwater interaction. Implemented 2002.	Continuing	SFWMD
Enhance Implementation of Citrus Pesticide BMPs in St. Lucie Estuary Watershed	Improve pesticide spray practices to reduce environmental contamination and improve efficacy. Assess precision spray application.	In Progress	UF, IFAS, IRREC, Ft. Pierce
St. Lucie River Watershed Assessment	Assessments of the C-25, C-23, C-44, and Tidal St. Lucie basins, and Basins 1, 4, 5, and 6	Completed	SFWMD
BMPs for citrus and vegetable crops to evaluate nutrient and metal loading	Characterization of nitrogen, phosphorus, and heavy metals in surface water runoff from citrus groves and vegetable fields in the IRL/SLE Watershed	In Progress	UF, IFAS, IRREC, Ft. Pierce
Estuary Water Quality Model	Currently in development anticipated completion data for all phases 2003.	In Progress	SFWMD
Environmental Toxicity in St. Lucie Estuary/Indian River Lagoon	NOAA study of adverse biological effects associated with chemical contamination	In Progress	NOAA
Martin County GIS	Geographic Information Systems (GIS) work to support a storm water management program	Completed	Martin County
BMPs for Citrus and vegetable Crops to Improve Surface Water Quality	Demonstrate effects and desirability of using newly developed best management practices for citrus and vegetable production in the IRL/SLE watershed	In Progress	UF, IFAS, IRREC, Ft. Pierce
Citrus herbicide BMP effects on the quality of off site discharges	Determine the influence of groundcover management on losses of herbicides to irrigation and drainage ditches in two different grove systems.	In Progress	UF, IFAS, IRREC, Ft. Pierce
Agrochemical and nutrient loadings and quality of runoff from golf, urban, pasture	Quantify nutrient and metal loadings from urban areas, golf courses, and pastures. Identify sites where pesticide losses in runoff maybe problem.	In Progress	UF, IFAS, IRREC, Ft. Pierce
Sediment Control BMP Evaluations for Indian River Citrus	Determine the ability of water furrow sediment traps to reduce phosphorus and copper losses in runoff. Compare sediment released from ditches where water levels are controlled by gates and riser boards	In Progress	UF, IFAS, IRREC, Ft. Pierce
Turbidity/Seagrass Study	Compare ecological characteristics and maximum growth of seagrasses at a location receiving colored water discharge and a location removed from the discharge near Ft. Pierce	Completed	SFWMD
Martin County Rain, Stage, Groundwater Stations	15 gauges at 12 sites rainfall, groundwater, stage data. Initiated January 2000.	Continuing	Martin County
Watershed Water Quality Model (WaSh)	Currently in development, anticipated completion data for all phases 2002.	In Progress	SFWMD
Upper East Coast (UEC) Water Supply Plan	Establish a framework for future water use decisions to provide adequate water supply for urban areas, agriculture, and the environment.	Completed	SFWMD

continuously at 15-minute intervals. Salinity and temperature are measured at two different depths to detect stratification in the water column. The data collection program was expanded in January 1999, when five more tide/salinity stations were installed in the South IRL between Ft. Pierce Inlet and Pecks Lake. The SFWMD has had on-going water quality sampling programs within the South IRL system. Since 1988 SFWMD conducted quarterly sampling for physical parameters, nutrients, photosynthetically active radiation (PAR), and chlorophyll, at 40 sites within the South IRL.

As previously noted, modifications have been made to the South IRL water quality-monitoring network to better understand the water quality/seagrass link in the South IRL (Figure 6-2). The SFWMD has used water quality data collected over ten years in the Indian River Lagoon at station C25S50 in the Belcher Canal (C-25) in order to conduct analyses for total phosphorus (TP), total nitrogen (TN), dissolved oxygen (DO), and turbidity. The SFWMD has also collected quarterly samples for pesticide and heavy metal analysis at the S-80 structure on C-44 and the S-99 structure on C-25. As part of an effort to evaluate potential toxic effects of contaminants on estuarine biota (macroinvertebrates), the FDEP has collected quarterly samples for nutrients, pesticide and heavy metals at the coastal structures in C-23, C-24, C-25, and C-44. The SFWMD and the FDEP water quality findings are in agreement: inflows to the South IRL and the St. Lucie Estuary contain excessive concentrations of nutrients, as well as, relatively frequent detections of pesticides and heavy metals. Pesticides at concentrations that exceed state water quality standards have been detected in all the monitored inflow sources other than the historic South Fork of the St. Lucie River.

To better understand the contribution of groundwater input to the St. Lucie Estuary & River and South IRL, a total of 15 monitor wells were recently installed at six sites (Figure 6-6).

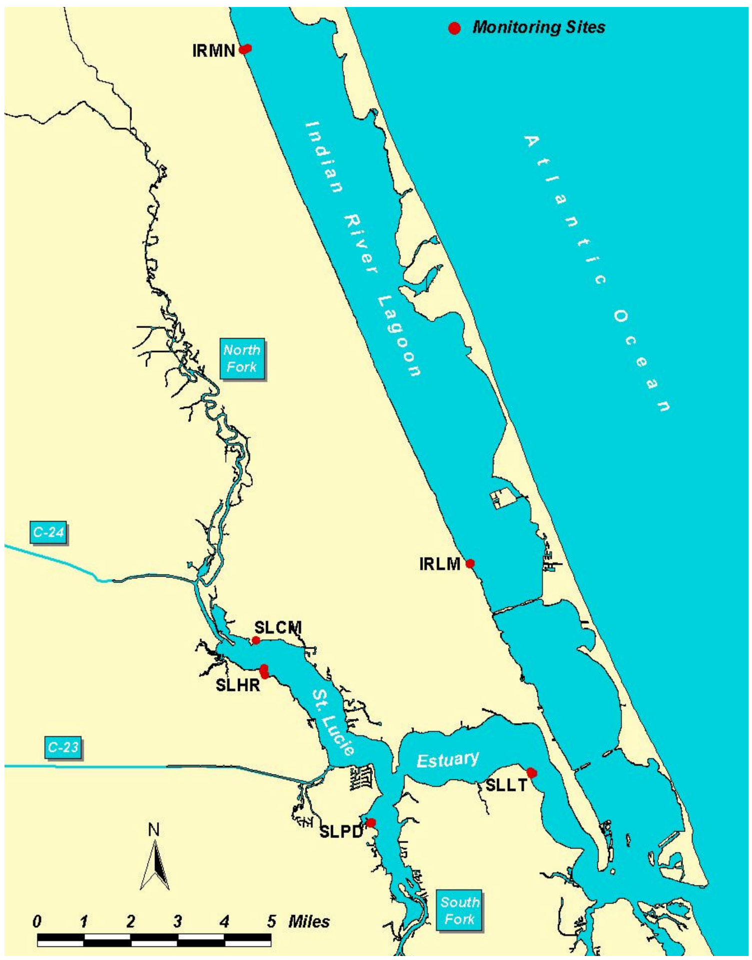


Figure 6-6. SLE/IRL Groundwater, Surface Water Interaction Studies - Location of Monitoring Stations.

Chemical characterization of groundwater and surface water is key to understanding the exchange and movement of the water (inflows and outflows), the spatial and temporal affects on the water, the aquifer, and solute movement to and from the aquifer and the surface water. Analysis of the field parameters, major ions, iron, manganese, Total Organic Carbon, Dissolved Organic Carbon, Total Dissolved Solids, and Total Suspended Solids, will allow evaluation of the water from different layers, the sampling or analytical inconsistencies, and the sampling problems. Analysis of the nitrogen and phosphorous parameters will address nutrient questions. Additional tests include Methyl Blue Activated Surfactants (MBAS), which measures surfactants (detergents) in water-- an indicator of possible input from septic systems.

Modeling

Under the SWIM Programs the SFWMD is mandated to develop Pollution Load Reduction Goals (PLRGs) in the South IRL. Development and application of computer models is a critical step in accomplishing this goal. In order to evaluate the effectiveness of pollutant reduction strategies, the modeling efforts will include predicting estuarine water quality parameters as a function of external inputs, internal hydrodynamics, relevant processes, and transformations occurring within the estuary. The reliability of a receiving water model depends on the accuracy of freshwater input data. A receiving water modeling project cannot succeed without dependable watershed input.

Hydrodynamic Modeling

Hydrodynamic modeling has been the primary tool in understanding changes within the South IRL and St. Lucie Estuary (Figure 6-7). It has been used to develop salinity-flow relationships under stable conditions and to study salinity shock within the estuary under storm-event conditions. A work plan for St. Lucie Estuary Modeling was developed in 1996. Plans for data collection and a bathymetric survey were developed in parallel. The tide/salinity-measurement network began in August 1997.

A 2-D salinity model was developed using the computer models RMA-2 and RMA-4, which were developed by Research Management Associates, Inc. under contract to the Army Corps of Engineers. The model was calibrated in 1998. The St. Lucie Estuary Hydrodynamics/ Salinity Model includes the North and South Forks of the St. Lucie River, the middle and lower St. Lucie Estuary, the St. Lucie Inlet, and the Indian River Lagoon between Nettles Island and Pecks Lake. The model computes tides (water surface elevation), two-dimensional velocity field and salinity distribution in the model domain. Since the main interest is the impact of watershed runoff on the overall salinity regime in the estuary, a 2-D depth averaged approach was considered sufficient.

The freshwater inflow in the salinity relationship includes both surface and subsurface (groundwater) input to the system. The model is two-dimensional; therefore it does not simulate the stratification in the water column. While depth averaged salinity is sufficient to describe the overall salinity regime on a macro scale, it does not reflect the salinity difference between surface layer and bottom layer when the system is stratified. For a more detailed look at water quality and biological study, it is necessary to consider the factor of stratification. Outputs generated by the St. Lucie hydrodynamics/salinity model have provided scientific support to the CERP IRL-South Plan and system operations. The model was also adapted and extended to predict salinities for the St. Lucie River Minimum Flows and Level (MFL) Study.